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Intelligence Report

Aims and Costs of the Soviet Space Station Program

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
January 1970

INTELLIGENCE REPORT

Aims and Costs of the Soviet
Space Station Program

Introduction

From the beginning of their manned space program the Soviets have displayed a strong interest in earth orbiting space stations. For example, as early as 1961 Soviet scientists predicted that the USSR would orbit a space station with a crew of three to five in the period 1967-70. The Soviets may consider that this particular prediction has been fulfilled since they claim that the January 1969 docking of Soyuz 4 and 5--which together carried a crew of four--produced "the world's first piloted experimental orbital station."

It is clear that the Soviets see this feat as only an initial effort--they described it as "an important step in developing more powerful orbital scientific stations for various purposes." Party chief Leonid Brezhnev, in a speech at the Kremlin honoring the crews of Soyuz 6, 7, and 8 in October 1969, asserted that Soviet scientists regard the construction of orbital stations as "man's main road to space" and

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that large scientific orbiting laboratories "will be built." A seemingly authoritative article in the August 1969 issue of *Kryl'ya Rodiny* (Wings of the Homeland, the official journal of the Soviet para-military organization DOSAAF) predicted that, in addition to space stations using the Soyuz, stations weighing "tens of tons" with active lifetimes of "several months" and stations weighing "hundreds of tons" with active lifetimes of "several years" will be built and put into orbit.

This report deals with three types of space stations which the Soviets may orbit during the coming decade. The first of these, a station composed of two Soyuz space capsules, is almost a certainty. The second, a 45,000 pound station, is considered probable, and the third, a 300,000 pound station, is a possibility. This report discusses the potential uses of such stations and estimates the cost of the programs. A summary appears on page 13.

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POTENTIAL SOVIET UTILIZATION OF MANNED SPACE STATIONS

Civilian Economic Uses

Discovery of new mineral and petroleum deposits
Monitoring of crop development, plant diseases, and attacks by insects
Hydrographic survey, including pollution and flood control
Oceanographic survey, including the location of high density schools of fish (A Soviet article has predicted that the annual catch of fish could be increased by up to 20 percent by satellite spotting.)
Survey of forest resources, including forest fire spotting
Navigational control of ships and aircraft
Manufacturing which would take advantage of unique conditions of space, such as growth of crystals and formation of perfect spheres

Civilian Scientific Uses

Astronomical observatory outside the earth's atmosphere
Study of near-earth space and atmosphere
Unique scientific laboratory where experiments can be conducted under conditions of weightlessness, near-perfect vacuum, and absolute zero temperature
Launching base for manned lunar and interplanetary flight
Study of high energy physics
Study of long term effects of space environment (radiation, weightlessness) on man

All the above have been mentioned in the Soviet press as possible uses for a space station. The Soviets have not specifically discussed military uses, but those listed below are the kinds of applications they may foresee. The activities listed as possible joint uses have been discussed by the Soviets although their military implications have not.

Military Uses

Direct and immediate observation and reporting on strategic and tactical areas of interest
Platform for advanced sensors and detectors
Alternate command and control center

Joint Military-Civilian Uses

Real time meteorology
Cosmonaut training
Geographic and geological observation and mapping

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Soviet Views of Space Station Utilization

M. V. Keldysh, president of the USSR Academy of Sciences, issued a definitive statement in late November 1969:

The Soviet space program calls for a permanent orbital station that could solve many cardinal problems in physics, geo-physics, and astrophysics and promote the practical affairs of mankind. Orbital stations could promote the most rational use of the wealth of the earth and advance geology, meteorology, agriculture, forestry, fishing, and oceanography to new heights. They will be important for voyages to the planets of the solar system and for further space exploration.

This statement is almost a complete summary of the civil uses for a space station as they have been postulated in the USSR. (The chart on the opposite page lists potential civilian and military applications.)

Although official statements and unofficial comments by Soviet scientific and technical personnel and cosmonauts have dealt only with the civil aspects of a space station program, past activity indicates that the stations will probably have military as well as civil uses. During the combined flight of Soyuz 6, 7, and 8 in October 1969 three SS-7 ICBMs were fired from the Tyuratam missile test center. In each instance at least one of the manned Soyuz vehicles was in a good position to observe the rangehead at launch time. These firings broke a six month hiatus in SS-7 firings from Tyuratam, and were probably scheduled as part of an experiment concerned with the early warning and intelligence collection capabilities of manned orbiting space stations.

Space Stations and the Manned Lunar Landing Program

Soviet scientists attending international meetings concerned with space flight have recently given several US scientists the impression that the USSR is giving priority to manned orbiting space stations. The implication, in light of public statements like those of Brezhnev and Keldysh noted above, is that the Soviets have downgraded their manned lunar landing program and have placed new emphasis on space stations. Keldysh has, in fact, been quoted by a Western news agency as saying during an interview in October 1969 that "At the moment, we are concentrating wholly on the creation of large satellite stations. We no longer have any scheduled plans for manned lunar flights."

It is too early, however, to conclude that space stations have been elevated to the priority position in the Soviet space program. At a press conference held after the flights of Soyuz 6, 7, and 8, Keldysh said that the Soviet space program had no particular emphasis but was "advancing on a broad front." There is no direct evidence that the Soviets are shifting resources from the facilities and hardware specifically designed to support a manned lunar landing to those elements intended to support a manned space station.

One reason for the public stress on space stations and de-emphasis of manned lunar landings may be the success of the US Apollo program. By contrast, the Soviets have reportedly been having difficulties with the launch vehicles which could be used for the manned lunar landing and they may be reluctant to discuss in detail any plans for a lunar venture in the face of the uncertain reliability of these vehicles.

Another factor that may have persuaded the Soviets to emphasize their space station program in public media is the potential short run economic benefits they foresee from a manned orbiting space station in contrast to the longer run potential gains from exploration of the moon and the planets. There are indications--as reported by Western correspondents,

by the US Embassy in Moscow, and by US scientists who have contact with their Soviet counterparts--that there are significant pressures to limit expenditures for space exploration in the USSR. Some of the most effective pressure is probably being applied by managers of civil and military R&D programs who would like to get part of the space budget reallocated to their own projects.

Estimated Space Station Costs

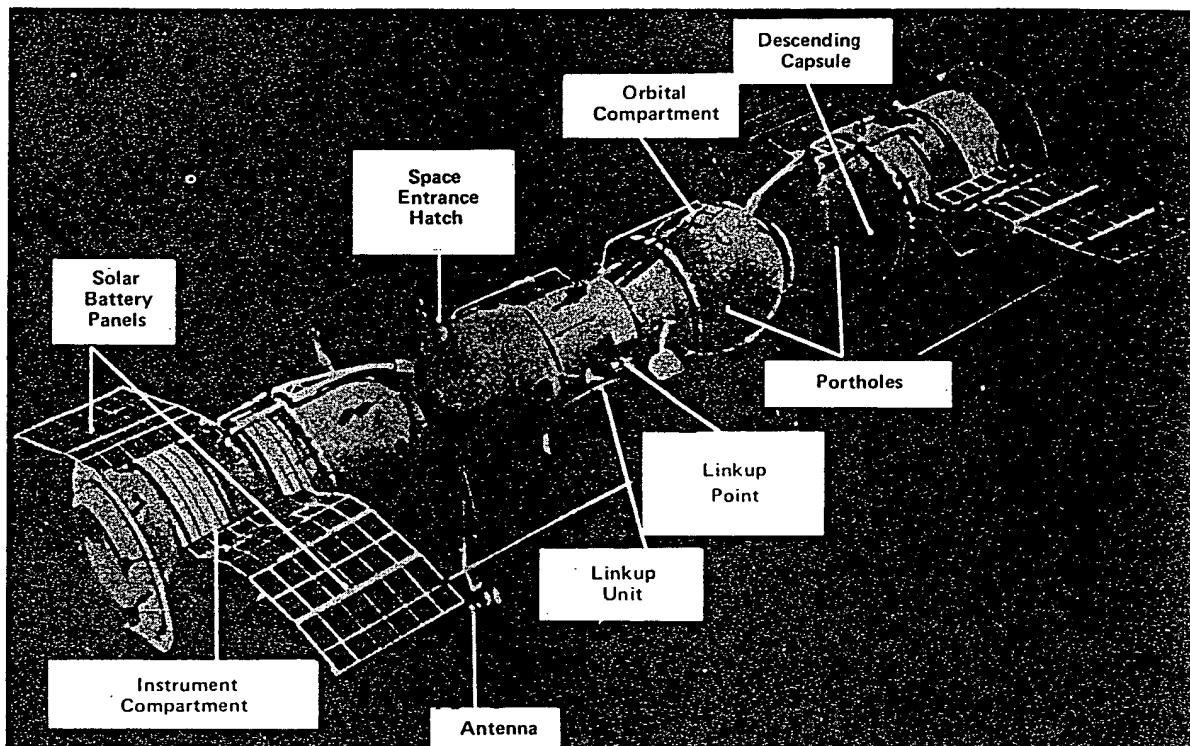
The stations postulated in this paper are not specific predictions of future Soviet space stations. The Soviets have a wide range of options and they probably have not worked out all the details of their plans for manned space stations. The postulations are based as far as possible on what the Soviets have stated about future stations, and the assumptions used here about the size of the crew and the duration in orbit, along with the characteristics of the manned space stations, are consistent with Soviet capabilities. As long as the weight, station lifetime, and size of crew for actual stations remain about the same as postulated, the costs for a series of three types of station should remain reasonably close to those estimated.

Cost estimates are based on the technical characteristics of Soviet space systems as they have been described in both classified and unclassified publications. Where descriptions are incomplete, assumptions based on past Soviet practices have been made to enable cost estimates to be completed. The observed and assumed technical characteristics are then used with computerized cost estimating models developed for US use. The resulting cost estimates are for Soviet systems computed as though the systems were constructed in the US. This method gives a relative measure of the amount of effort being expended by each of the two countries by allowing direct comparison of expenditures.

The estimated cost to the Soviet Union to build and orbit the three increasingly advanced types of space station discussed below is about 7 billion

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A Soviet Concept of the Hookup of Two Soyuz Spacecraft



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This artist's concept distributed by Tass in October 1969 shows two Soyuz spacecraft after rendezvous and docking operations have linked them together. Each spacecraft may carry up to three men in short flights of this kind but the entire crew for this type of space station would probably not exceed a total of three men.

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dollars, excluding launch vehicle development costs. The estimated cost of a manned lunar landing--also excluding the development costs for the launch vehicle--is of approximately the same magnitude. Characteristics and cost data are summarized in the table on page 14.

A Soyuz Space Station

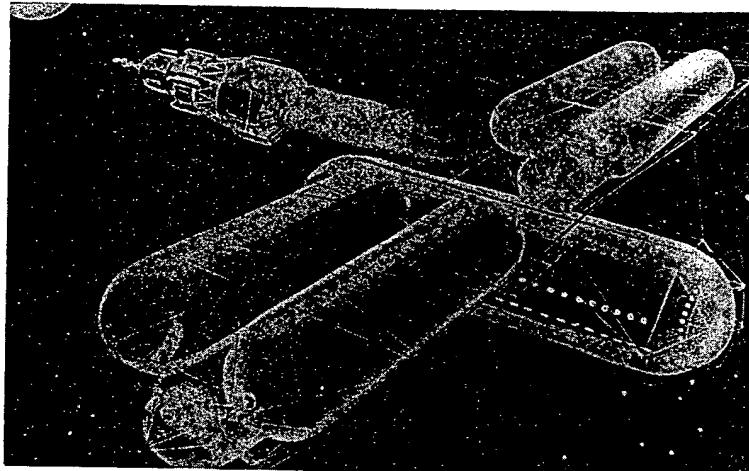
The Soviets claim that the docking of Soyuz 4 and 5 in January 1969 constituted the world's first experimental space station (see illustration facing). Soyuz 7 and 8, which were orbited in October 1969 were almost certainly intended to repeat and expand upon this experience. These spacecraft did not dock, however, and further attempts may have to be made to refine rendezvous and docking techniques before a station consisting of two Soyuz spacecraft is orbited for a longer period of time. It would also be desirable to develop and test a means of direct crew transfer from one docked Soyuz to the other without extravehicular activity.

The estimated cost of a program to orbit stations made up of pairs of Soyuz spacecraft is the equivalent of approximately 800 million dollars, with funding spread over the years 1965-73. This does not include the development costs for either the spacecraft or the SL-4 booster, both of which have been used for other missions.

Included in the estimated 800 million dollars are the expenditures for the five missions on which two Soyuz vehicles have already been flown together. On two of these missions both craft were unmanned, on two both were manned, and in the fifth mission one capsule was manned and the other unmanned. The unmanned pairs of vehicles were successfully docked in both cases, as were Soyuz 4 and 5, one of the manned pairs. The other two missions successfully rendezvoused but failed to dock.

Each mission of two Soyuzes is estimated to cost the equivalent of 60 million dollars. The total estimated program cost allows for eleven paired flights--

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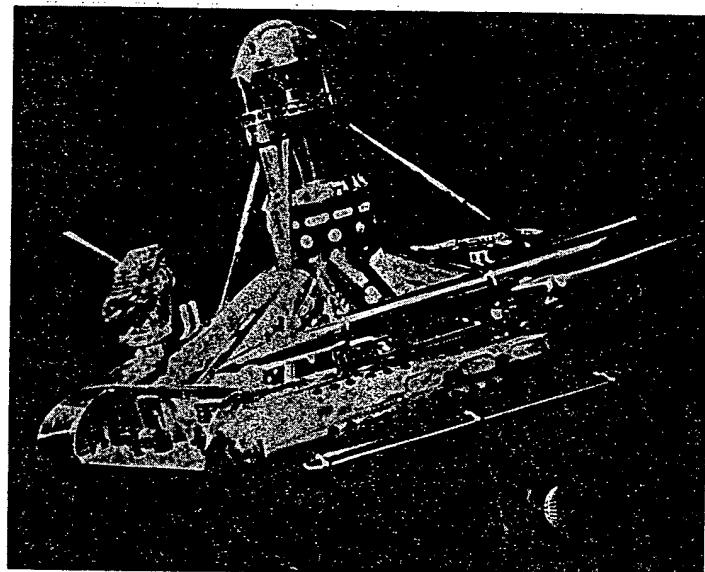


Two Soviet Space Station Concepts

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A number of space station designs have appeared in Soviet media. The painting above depicts a lunar mission being launched from a space station.

Although this painting and the model below should not be taken to represent the final form or size of the type of Soviet space stations discussed in this paper, some of the features displayed by these two designs may be incorporated in operational stations.



Soviet working model of a large doughnut shaped space station

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three more flights to perfect rendezvous and docking techniques and crew transfer systems and three flights of operational space stations.

The remainder of the estimated cost is for support operations and the development of experiments to be performed at the station. Support costs include astronaut training, systems integration, recovery, and other indirect costs.

A 45,000 Pound Space Station

A program to orbit a 45,000 pound space station would probably use the SL-12 launch vehicle and would cost about 1.3 billion dollars spread over the years 1969-1974. About half this total is the cost of launching eight Soyuz spacecraft as ferry vehicles for crew rotation and an additional twelve Soyuzes fitted out as cargo carriers for resupply. The one year duration in orbit of a 45,000 pound space station makes such launches necessary.

The cost of the station itself, including its launching, represents only about one-fourth of the total program cost. The remainder is allocated for support, resupply, and the building of a prototype station for ground testing.

One factor which may delay this program is the poor performance record of the SL-12. If the high failure rate of this launch vehicle continues, the estimated 1973-75 launch date may be pushed back considerably.

A 300,000 Pound Space Station

A space station weighing 300,000 pounds could be launched by a new, more powerful launch vehicle which the Soviets are expected to have sometime during the Seventies. Expenditures required for a space station of this size are estimated at slightly more than 5 billion dollars, excluding development costs for the launch vehicle. Such a station, although nearly seven times as heavy as the 45,000 pound station, would probably cost only about four times as much.

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The cost includes 640 million dollars for support and 1.3 billion dollars for development and testing of system components. Resupply costs--using the SL-12 as an integrated ferry vehicle for both resupply and crew rotation at a rate of nine flights a year--are estimated to be 2.6 billion dollars for a five-year period. If the Soviets intend to launch such a station in 1976, costs would probably be spread over the period 1970-79.

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Summary

The Soviet Union has long expressed an intense interest in manned orbital space stations, and recently Soviet scientists have concentrated their public comments on the space station program almost to the exclusion of a manned lunar landing attempt. Technical difficulties with the Soviet manned lunar landing program are probably responsible for this emphasis on space stations.

The Soviets have stated that they expect to gain substantial economic benefits from manned space stations, especially in the area of natural resource management. They may also expect to use such stations for military purposes, although they have not publicly admitted this. In addition, if the Soviets successfully carry out a manned space station program they may partially recoup some of the prestige recently lost to the US Apollo program, although such a feat would not have an impact on world opinion comparable to that produced by a manned lunar landing.

If the USSR embarks on a space station program similar to the one postulated in this paper, it may spend the equivalent of about 7 billion dollars over the next 10 to 15 years--approximately the estimated cost of a manned lunar landing program--on the development and launching of three progressively larger types of manned space stations:

The program cost for the first of these three types--consisting of two docked Soyuz spacecraft--is estimated to be the equivalent of about 800 million dollars. Such an operational station may be orbited for the first time in 1970.

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Projected Soviet Space Station Characteristics and Costs

Station	Launch vehicle	Ferry vehicle	Number in crew	Number of operational stations	Number of annual flights for resupply and crew rotation	Postulated date of launch	Station life	Total program cost* (billion 1966 dollars)
<hr/>								
Twin Soyuz (29,000 pounds)	SL-4	none	3	3	none	1970	10-30 days**	0.8
<hr/>								
45,000 pound	SL-12	SL-4 and Soyuz	6	1	12 resupply, 8 rotation	1973-75	1 year	1.3
300,000 pound	New launch vehicle	SL-12 with new space-vehicle	24	1	9 (crew and cargo in one spacecraft)	1976-80	5 years***	5.0

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* Launch vehicles serve more than one program and their development costs are not included.

** With modification a twin Soyuz space station could have a potential life in orbit of 90 days or more. No resupply missions are necessary and an extended life version would not materially affect the cost estimate.

*** Station life could be indefinite. Five years is assumed for costing purposes.

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A 45,000 pound station to be launched between 1973 and 1975 and costing about 1.3 billion dollars is likely if the Soviets overcome their current problems with the SL-12 launch vehicle.

A station in the 300,000 pound class and costing about 5 billion dollars may be scheduled for the 1976-80 period.

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